

Digital Imaging Illuminates Question of Ideal Room Lighting

THE ongoing shift to viewing digital images on computer monitors, rather than a traditional film on a lightbox, has brought a new issue to light—ambient room light, that is.

“We were a little concerned that the viewing environments in which radiologists look at clinical images were not optimum in terms of light levels,” said Patrick C. Brennan, Ph.D., lead author of an ambient light study published recently in the *American Journal of Roentgenology*. “Suddenly with this move from film to looking at an image on a monitor, the light levels from the screen were significantly less,” said Dr. Brennan, a professor in the School of Medicine and Medical Sciences at the University College Dublin in Ireland.

Existing guidelines include World Health Organization (WHO) and Commission of European Communities (CEC) standards for ambient lighting in viewing environments, which suggest 100 lux at 30 centimeters and 50 lux at 100 centimeters, respectively. Dr. Brennan pointed out, however, that the WHO standards were created more than 20 years ago for film viewing. Even the CEC standards, less than 10 years old, are still out of date due to the rapid increase in digital viewing, he said.

In 2005, the American Association

of Physicists in Medicine released an extensive series of tables detailing the optimal light levels for viewing filmless images based on a variety of variables, including screen and monitor surface reflections. Yet those standards were so specific that they became impractical for use in the average hospital or clinic environment where there might be hundreds of monitors, all of different types and in different locations, said Dr. Brennan. What he wanted was a simple standard that would be more useful in the average situation. “When you go into a room, what should the light level be for a typical monitor?” he asked.

Dark Room Not Best Viewing Environment

Dr. Brennan’s study, done in conjunction with the American Board of Radiology, tested five ambient light levels: 480 lux (near the average office light level), 100 lux, 40 lux, 25 lux and 7 lux. Seventy-nine experienced radiologists examined 30 wrist images on liquid crystal display (LCD) monitors to determine the presence of a fracture. Results showed the fewest diagnostic errors at a level between 40 and 25 lux, which Dr. Brennan compared to a dim hotel room

at night. Researchers also found that the errors and misdiagnoses that did occur at appropriate lighting levels were usually false-positives rather than missed fractures.

Dr. Brennan said he was also surprised to find that, contrary to conven-

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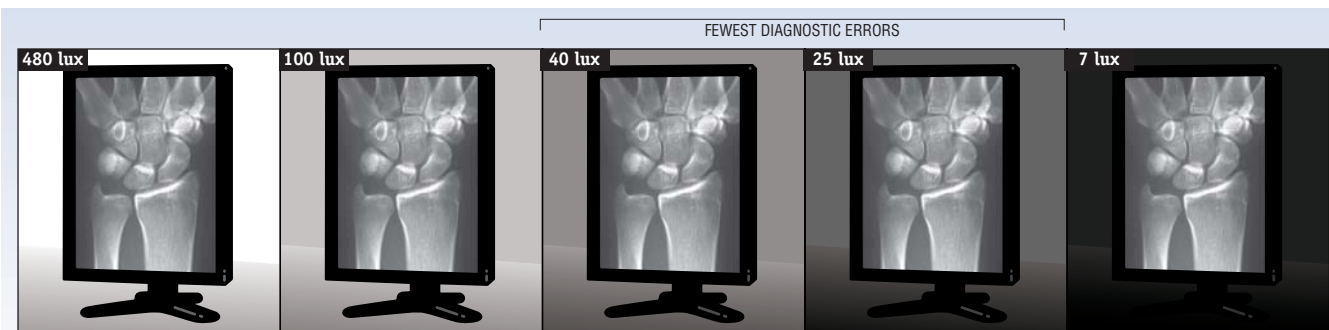
Patrick C. Brennan, Ph.D.

tional wisdom, a completely dark reading room does not provide the best viewing environment. “We showed that when you remove all ambient light and have the traditional envi-

ronment we would expect in a radiologist’s office, with the onscreen image shining out of the midst of complete blackness, you do not get a better reading,” he said.

Dr. Brennan consulted data presented by imaging display specialists Michael J. Flynn, Ph.D., a diagnostic radiology researcher with the Henry Ford Health System in Detroit, and Aldo Badano, Ph.D., a staff fellow in the FDA’s Center for Devices and Radiological Health. They explained that because the eye adapts to the average brightness of a room, its ability to discriminate between gray levels is best when the ambient light level of the room is close

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Experienced radiologists reading wrist images at five ambient light levels made the fewest diagnostic errors between 40 and 25 lux, a level researchers compare to a dim hotel room at night. The average office light level is near 480 lux.

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to the amount of light coming from the screen. In total darkness, on the other hand, the eye adjusts downward toward the lower average brightness.

Dr. Brennan wondered if his study might have underestimated the impact of the environment on image viewing—identifying wrist fractures was “maybe a little too easy,” he said—and therefore sought something more challenging to help discriminate between the variables. A study of radiologists asked to detect chest lesions yielded results similar to those of the wrist study and was presented at the International Society for Optical Engineering (SPIE) medical imaging conference in San Diego in February.

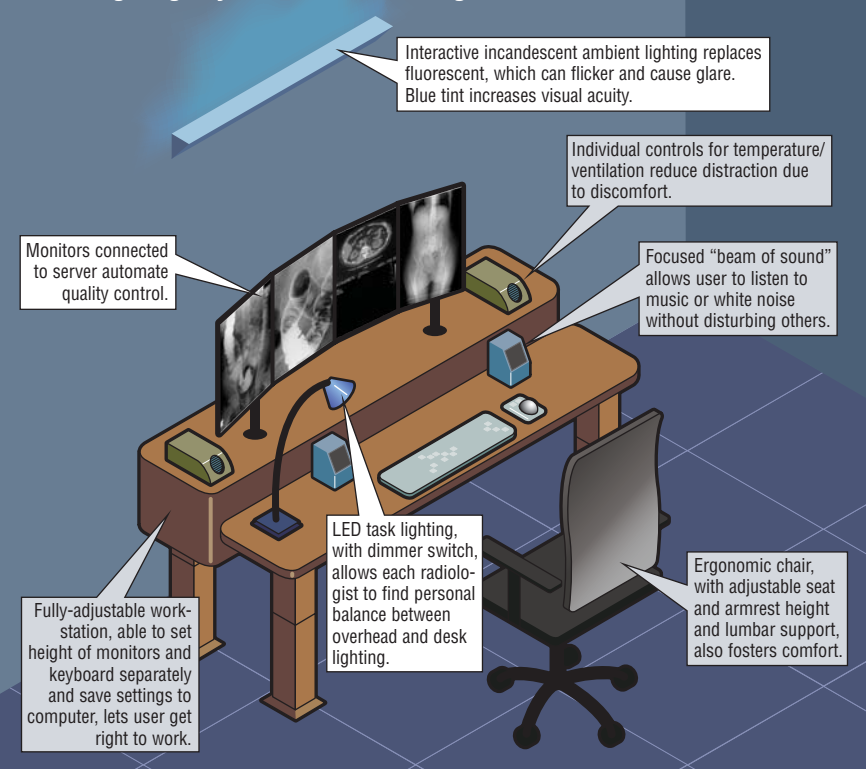
Ambient Lighting Addressed in Futuristic Reading Room

Optimal reading environments is one of the hottest topics in radiology right now, said Eliot L. Siegel, M.D., who helped create what has been called “the reading room of the future”—a prototype, best case scenario for interpreting images on a Picture Archiving and Communication System (PACS), housed at the Baltimore Veterans Affairs (VA) Medical Center.

The model reading room features computer-controlled lighting at the workstations, including presets that allow various users to instantly adjust the lighting to their preferred levels. The room also uses blue lighting to increase visual acuity.

“What we believe is really important is to have the proper match between the brightness of the monitor

Correct Lighting Key Part of Ideal Reading Environment



Information courtesy of “Innovation in Reading Room Design” by GE Healthcare and Baltimore Veterans Affairs Medical Center. Artwork by Adam Ingly.

and the brightness of the background light,” said Dr. Siegel, professor and vice-chair of the Department of Diagnostic Radiology in the University of Maryland School of Medicine and chief of radiology and nuclear medicine for the Maryland VA Healthcare System.

“We also believe it’s optimal to give each radiologist control of the overhead lights,” Dr. Siegel added. The reading room does not use fluorescent lights because of the flicker and the associated glare, he said, but instead features interactive incandescent lighting with a dimmer switch. Light-emitting diode (LED) lighting technology also allows each radiologist to find a personal balance between overhead and desk lighting at the reading stations. The presets even allow users to set lighting levels to change over the course of a day in order to adjust to how human visual acuity changes.

Dr. Brennan said he hopes all the research will help bring about not only newer and more relevant international standards for ambient light levels, but also ones to which radiologists feel they can adhere. In a separate study of light levels in three radiologic environments, Dr. Brennan found that monitors were being viewed in conditions suggested

by WHO in only 75 percent of cases and in line with CEC standards in just 45 percent. The study was published in the February 2003 issue of the *British Journal of Radiology*.

More importantly, a study Brennan published in the Spring 2007 issue of the *Canadian Journal of Medical Radiation Technology* indicated that when viewing images in environments outside radiology departments or offices, physician adherence to the standards dropped to just 7 percent. “Light levels vary hugely in a clinical environment,” said Dr. Brennan. “These days, there’s a 50 percent chance that your image will be judged in an outpatient clinic, emergency department or other non-optimal lighting environment.” □

Lighting Issues at RSNA 2007

“Workstation Design,” one of numerous informatics refresher courses to be offered at RSNA 2007, will address issues of reading room ergonomics along with hardware and software options. Registration for this and all RSNA 2007 courses begins June 18. More information will be available at RSNA2007.RSNA.org.



Learn More

More information about the studies cited in this article is available online.

- “Ambient Lighting: Effect of Illumination on Soft-Copy Viewing of Radiographs of the Wrist” www.ajronline.org/cgi/content/abstract/188/2/W177.
- “Viewing conditions for diagnostic images in three major Dublin hospitals: a comparison with WHO and GEC recommendations” bjr.birjournals.org/cgi/content/full/76/902/94.